

Project Summary: NASA Solar Wind Health Alert System

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GitHub: <https://github.com/ilyaemelian/solar-wind-dashboard>

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Project Overview

SolarWind Dashboard is a real-time space weather monitoring system designed to protect health-sensitive populations from geomagnetic disturbances. The system uses NASA/NOAA solar wind data to provide early warnings for cardiovascular patients, elderly individuals, and other weather-sensitive people.

Key Achievement

Winner at the 33rd International Space Olympiad - demonstrating practical application of scientific computing and data engineering skills with real satellite datasets.

Problem Statement

Geomagnetic storms caused by solar activity can significantly impact human health, particularly:

- Cardiovascular patients:** Increased risk of heart attacks and strokes during G3+ storms
- Elderly individuals:** Heightened sensitivity to geomagnetic disturbances
- Weather-sensitive people:** Discomfort, fatigue, and sleep disturbances

Current space weather monitoring systems are designed for technical applications but lack health-focused alerting for vulnerable populations.

Solution

A Python-based system that:

- Ingests real-time data** from NOAA Space Weather Prediction Center
- Processes and filters alerts** relevant for health-sensitive people (G3 and above)
- Provides multi-language support** (English/Russian) for broader accessibility
- Generates professional visualizations** for research and presentation
- Assesses health impact** with specific warnings for different risk groups

Technical Implementation

Core Technologies

- Python 3.8+** with scientific computing libraries
- Data Processing:** numpy, pandas for time series analysis
- Visualization:** matplotlib, plotly for high-quality graphics
- API Integration:** Real-time data from NASA/NOAA endpoints
- Translation:** Multi-language support for international use

System Architecture

```
solar-wind-dashboard/  
├── src/  
│   ├── alerts/           # Alert models with health impact assessment  
│   ├── data_ingestion/   # NOAA API integration  
│   ├── translation/      # Multi-language support  
│   └── visualization/    # Professional graphics generation  
├── visualizations/       # High-resolution charts (1920x1080)  
└── docs/                 # Project documentation
```

Key Features

- Real-time ingestion from NASA endpoints (solar wind, Bz, Kp, particle flux)
- Health-focused alert filtering (G3+ for weather-sensitive people)
- Severity classification based on NOAA scale (G1-G5)
- Professional visualizations suitable for academic presentations
- Bilingual interface (EN/RU)

Impact and Applications

Social Impact

- Protects **vulnerable populations** by providing early warnings
- Increases **awareness** of space weather health effects
- Enables **proactive health management** for at-risk individuals

Academic Value

- Demonstrates **scientific computing** skills with real NASA data
- Shows **data engineering** capabilities (real-time processing, API integration)
- Highlights **software development** practices (modular architecture, documentation)
- Provides **reproducible research** framework

Research Applications

- Suitable for **publications** in space weather and health journals
- Can be extended for **epidemiological studies** linking geomagnetic activity to health outcomes
- Provides **data pipeline** for further research

Technical Highlights

1. **Real-time Data Processing:** Continuous monitoring of NOAA Space Weather Prediction Center
2. **Intelligent Filtering:** Automatic identification of health-relevant alerts (G3+)
3. **Professional Visualization:** High-resolution graphics (1920×1080) for presentations and publications
4. **Modular Architecture:** Clean, maintainable code structure suitable for academic review
5. **Comprehensive Documentation:** README, code comments, and technical reports

Project Status

🚀 Production-Ready System

- Successfully demonstrated at **33rd International Space Olympiad**
- Won the competition
- Real-time data ingestion operational
- Alert processing and filtering fully implemented
- Health impact assessment functional
- Professional visualizations generated
- Multi-language support active

Future Enhancements

- Integration with health monitoring devices
- Machine learning for predictive modeling
- Mobile application for alerts
- Extended language support
- Historical data analysis capabilities

Repository

GitHub: <https://github.com/ilyaemelian/solar-wind-dashboard>

Live Demo: <https://ilyaemelian.github.io/solar-wind-dashboard/>

Conclusion

This project demonstrates the ability to:

- Work with **real scientific data** from NASA/NOAA
- Apply **scientific computing** skills to solve real-world problems
- Create **socially impactful** software
- Develop **professional-grade** academic projects
- Integrate **multiple technologies** (data science, API integration, visualization)

The system successfully bridges space weather science and public health, providing a practical tool for protecting vulnerable populations while demonstrating strong technical and academic capabilities.

Author Information

Ilya Emelianov

Developer and Creator

- **GitHub:** <https://github.com/ilyaemelian>
- **Repository:** <https://github.com/ilyaemelian/solar-wind-dashboard>
- **Live Demo:** <https://ilyaemelian.github.io/solar-wind-dashboard/>

This project was developed independently as part of academic work and won the **33rd International Space Olympiad**.

Project Type: Scientific computing, Data engineering, Software development
Status: Production-ready (successfully demonstrated at 33rd International Space Olympiad)
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